

CLAIMS TO INVENTION:

33. A planar laser illumination and imaging (PLIIM) based system comprising:

a system housing having first, second and third light transmission apertures linearly aligned with and optically isolated from each other, and said third light transmission aperture being disposed between said first and second light transmission apertures;

a linear image formation and detection module disposed in system housing, and having image formation optics with a field of view projectable through said third light transmission aperture and onto an object moving relative to said first, second and third light transmission apertures during object illumination and imaging operations; and

a pair of planar laser illumination arrays (PLIAs) disposed on said system housing, each said planar laser array (PLIA) including a plurality of laser diodes arranged together in a linear manner and said planar laser illumination arrays being arranged in relation to said linear image formation and detection module, and for producing a pair of planar laser illumination beams (PLIBs), and projecting said pair of stationary planar laser illumination beams through said first and second light transmission apertures and oriented such that the plane of said planar laser illumination beams is coplanar with the field of view of said linear image formation and detection module so that the object can be simultaneously illuminated by said planar laser illumination beams and imaged within said field of view of said linear image formation and detection module,

whereby a series of linear images of said object are sequentially detected by said linear image formation and detection module as said object moves past first, second and third light transmission apertures, so that said series of linear images can be grabbed and buffered for subsequent use in constructing two-dimensional images of said object.

34. The PLIIM based system of claim 33, which further comprises:

an image frame grabber for grabbing images formed and detected by said image formation and detection module,

an image data buffer for buffering said grabbed images;

an image processing computer operably associated with said image data buffer, for processing said buffered images; and

a camera control computer for controlling said linear image formation and said detection module, and said pair of planar laser illumination arrays.

35. The PLIIM-based system of claim 33, wherein said image forming optics have a fixed focal distance and a fixed focal length providing a fixed field of view.

36. The PLIIM-based system of claim 33, wherein said image forming optics have a variable focal distance and a fixed focal length providing a fixed field of view.

5 37. A PLIIM-based system of claim 33, wherein said image forming optics have a variable focal distance and a fixed focal length providing a fixed field of view.

38. A PLIIM-based system of claim 33, wherein said image forming optics have a variable focal distance and a variable focal length providing a variable field of view.

10 39. A PLIIM-based system of claim 33, wherein said system housing has a unitary construction.

40. An over-the-conveyor belt package identification system embodying the PLIIM-based system of claim 33.

15 41. A hand-supportable bar code symbol reading system embodying the PLIIM-based system of claim 33.

42 A planar laser illumination and imaging (PLIIM) based system comprising:

20 a system housing having first, second and third light transmission apertures linearly aligned with and optically isolated from each other, and said third light transmission aperture being disposed between said first and second light transmission apertures;

25 a linear image formation and detection module, disposed in said system housing, and having a linear detection array and image forming optics with a field of view projectable through said third light transmission aperture and onto an object moving relative to said first, second, and third light transmission apertures during object illumination and imaging operations;

a stationary field of view folding mirror, disposed in said system housing, for folding the field of view of said linear image formation and detection module in a predetermined direction with respect to said third light transmission aperture;

30 a pair of planar laser illumination arrays (PLIAs) disposed in said system housing, each said planar laser illumination array including a plurality of laser diodes arranged in a linear manner and said planar laser illumination arrays being arranged in relation to said linear image formation and detection module, and producing a first and second planar laser illumination beams (PLIBs);

35 a pair of stationary planar laser beam folding mirrors disposed in said system housing, and arranged so as to fold the optical paths of said first and second planar laser illumination

beams such that the planes of said first and second planar laser illumination beams are projected through said first and second light transmission apertures and oriented in a direction that is substantially coplanar with the field of view of said linear image formation and detection module so that the object can be simultaneously illuminated by said first and second planar laser illumination beams and imaged within the field of view of said linear image formation and detection module,

whereby a series of linear images of said object are sequentially detected by said linear image formation and detection module as said object moves past said first, second and third light transmission apertures, so that said series of linear images can be grabbed and buffered for subsequent use in constructing two-dimensional images of said object.

43. The PLIIM-based system of Claim 42, which further comprises:

an image frame grabber, disposed within said system housing, for grabbing images formed and detected by said linear image formation and detection module,

an image data buffer, disposed within said system housing, for buffering said grabbed image;

an image processing computer, operably connected to said image data buffer, for processing said buffered image; and

a camera control computer, disposed within said system housing, for controlling said linear image formation and said detection module.

44. The PLIIM-based system of claim 41, wherein said image forming optics have a fixed focal distance and a fixed focal length providing a fixed field of view.

45. The PLIIM-based system of claim 41, wherein said image forming optics have a variable focal distance and a fixed focal length providing a fixed field of view.

46. The PLIIM-based system of claim 41, wherein said image forming optics have a variable focal distance and a variable focal length providing a variable field of view.

47. A PLIIM-based system of claim 31, wherein said system housing has a unitary construction.

48. An over-the-conveyor belt package identification system embodying the PLIIM-based system of claim 41.

49. A hand-supportable bar code symbol reading system embodying the PLIIM-based system of claim 41.

50. A planar laser illumination and imaging (PLIIM) based system comprising:

5 a system housing having first, second and third light transmission apertures linearly aligned with and optically isolated from each other, and said third light transmission aperture being disposed between said first and second light transmission apertures;

10 a linear image formation and detection module disposed in said system housing and having a linear detection array and image forming optics with a field of view projectable through said third light transmission aperture and onto an object moving relative to said first, second and third light transmission apertures during object illumination and imaging operations;

15 a pair of planar laser illumination arrays (PLIAs) disposed in said system housing, each said planar laser illumination array including a plurality of laser diodes arranged together in a linear manner and said planar laser illumination arrays being arranged in relation to said linear image formation and detection module, and producing first and second planar laser illumination beams (PLIBs); and

20 a pair of stationary planar laser beam folding mirrors disposed in said system housing and arranged so as to fold the optical paths of said first and second planar laser illumination beams such that the planes of the first and second stationary planar laser illumination beams are projected through said first and second light transmission apertures and oriented in a direction that is coplanar with the field of view of said linear image formation and detection module so that the object can be simultaneously illuminated by said planar laser illumination beams and imaged within said field of view of said linear image formation and detection module;

25 whereby a series of linear images of said object are sequentially detected by said linear image formation and detection module as said object moves past said first, second and third light transmission apertures, so that said series of linear images can be grabbed and buffered for subsequent use in constructing two-dimensional images of said object.

51. The PLIIM-based system of Claim 50, which further comprises:

30 an image frame grabber, disposed within said system, for grabbing images framed and detected by said image formation and detection module,

an image data buffer, disposed within said system housing, for buffering said grabbed image;

35 an image processing computer, operably associated therewith, for processing said buffered image; and

a camera control computer for controlling said linear image formation and said detection module.

52. The PLIIM-based system of claim 50, wherein said image forming optics have a fixed focal distance and a fixed focal length providing a fixed field of view.

53. The PLIIM-based system of claim 50, wherein said image forming optics have a variable focal distance and a fixed focal length providing a fixed field of view.

54. The PLIIM-based system of claim 50, wherein said image forming optics have a variable focal distance and a variable focal length providing a variable field of view.

55. A PLIIM-based system of claim 50, wherein said system housing has a unitary construction.

56. An over-the-conveyor belt package identification system embodying the PLIIM-based system of claim 50.

57. A hand-supportable bar code symbol reading system embodying the PLIIM-based system of claim 50.

58. A planar laser illumination and imaging (PLIIM) based system comprising:

a system housing having first, second and third light transmission apertures linearly aligned with and optically isolated from each other, and said third light transmission aperture being disposed between said first and second light transmission apertures;

a linear image formation and detection module disposed in said system housing and having a linear detection array and image forming optics with a field of view projectable through said third light transmission aperture and onto an object moving relative to said first, second and third light transmission apertures during object illumination and imaging operations;

a field of view (FOV) folding/sweeping mirror, disposed in said system housing, for folding and sweeping the field of view of said linear image formation and detection module over a range of predetermined directions definable with respect to said third light transmission aperture;

a pair of planar laser illumination arrays (PLIAs), disposed in said system housing, each said planar laser illumination array including a linear array of laser diodes arranged together as a laser diode module, and said planar laser illumination arrays being arranged in relation to said

image formation and detection module, and producing first and second planar laser illumination beams (PLIBs);

a pair of planar laser beam folding/sweeping mirrors, disposed on said system housing, and jointly or synchronously movable with said FOV folding/sweeping mirror, and arranged so as to fold and sweep the optical paths of the first and second planar laser illumination beams through said first and second light transmission apertures, respectively, so that the folded field of view of said linear image formation and detection module is jointly or synchronously moved with said first and second planar laser illumination beams in a direction that is substantially coplanar therewith as said first and second planar laser illumination beams are swept over a 3-region of space so that the object can be simultaneously illuminated by said planar laser illumination beams and imaged within said field of view of said linear image formation and detection module,

whereby a series of linear images of said object are sequentially detected by said linear image formation and detection module as said object moves past said first, second, and third light transmission apertures, so that said series of linear images can be grabbed and buffered for subsequent use in constructing two-dimensional images of said object.

59. The PLIIM-based system of claim 59, which further comprises:

an image frame grabber, disposed within said system housing, for grabbing images formed and detected by said image formation and detection module,

an image data buffer, disposed within said system housing, for buffering said grabbed image;

an image processing computer, operably associated with said image data buffer, for processing said buffered image; and

a camera control computer, disposed within said system housing, for controlling said linear image formation and said detection module.

60. The PLIIM-based system of claim 59, wherein said image forming optics have a fixed focal distance and a fixed focal length providing a fixed field of view.

61. The PLIIM-based system of claim 59, wherein said image forming optics have a variable focal distance and a fixed focal length providing a fixed field of view.

62. The PLIIM-based system of claim 59, wherein said image forming optics have a variable focal distance and a fixed focal length providing a fixed field of view.

63. The PLIIM-based system of claim 59, wherein said image forming optics have a variable focal distance and a variable focal length providing a variable field of view.

64. A PLIIM-based system of claim 59, wherein said system housing has a unitary construction.

65. An over-the-conveyor belt package identification system embodying the PLIIM-based system of claim 59.

66. A hand-supportable bar code symbol reading system embodying the PLIIM-based system of claim 59.

67. A planar laser illumination and imaging (PLIIM) based system comprising:

a system housing having first, second and third light transmission apertures linearly aligned with and optically isolated from each other, and said third light transmission aperture being disposed between said first and second light transmission apertures;

a linear image formation and detection module disposed in said system housing, and having a linear detection array and image forming optics with a field of view projectable through said third light transmission aperture and onto an object moving relative to said first, second and third light transmission apertures, during object illumination and imaging operations; and

a pair of planar laser illumination arrays (PLIAs) disposed in said system housing, each said planar laser array including a plurality of laser diodes arranged together, and said pair of planar laser illumination arrays being arranged in relation to said linear image formation and detection module, and for producing a first and second planar laser illumination beams (PLIBs) and projecting said first and second planar laser illumination beams through said first and second light transmission apertures and oriented, such that the plane of said planar laser illumination beams is coplanar with the field of view of said linear image formation and detection module so that the object can be simultaneously illuminated by said planar laser illumination beams and imaged within said field of view of said linear image formation and detection module;

an image frame grabber, disposed in said system housing, for accessing linear images from said linear image formation and detection module;

an image data buffer, disposed in said system housing, for buffering said grabbed linear images received from said image frame grabber; and

a camera control computer, disposed in said system housing, for controlling the operation of said PLIIM-based system;

whereby a series of linear images of the object can be grabbed and buffered for subsequent use in constructing two-dimensional digital images of said object as said object moves past said first, second and third light transmission apertures.

69. A PLIIM-based system of claim 68, which further comprises:

an image processing computer, operably connected to said image data buffer, for receiving and buffering said series of linear images so as to construct said two-dimensional digital images, and for carrying out image processing algorithms (e.g. bar code symbol decoding algorithms) and operators on said two-dimensional digital images.

70. The PLIIM-based system of claim 68, wherein said image forming optics have a fixed focal distance and a fixed focal length providing a fixed field of view.

71. The PLIIM-based system of claim 68, wherein said image forming optics have a variable focal distance and a fixed focal length providing a fixed field of view.

72. The PLIIM-based system of claim 68, wherein said image forming optics have a variable focal distance and a variable focal length providing a variable field of view.

73. A PLIIM-based system of claim 68, wherein said system housing has a unitary construction.

74. An over-the-conveyor belt package identification system embodying the PLIIM-based system of claim 68.

75. A hand-supportable bar code symbol reading system embodying the PLIIM-based system of claim 68.